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■ Questions and Answers

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I had planned to start this section in the next issue and inviting readers to submit questions in this one. However, when we were about to go to press I received one interesting question, so here we launch the new section!

Please, submit your questions to <mailto:reader.questions@uv4plants.org>. I will answer those I am can, and forward other experts otherwise. Not all questions and their answers will be published, but we will attempt to quickly answer all of them through e-mail.

Extraterrestrial and ground-level solar spectrum

Q1: I was reading some literature with respect to the atmosphere and something keeps me puzzled. In the ASPB book “The molecular life of plants” (Jones, 2013; Page 280) they show a figure of the solar spectrum.

The red graph starts at 280 nm (extraterrestrial) while the blue one (ground level) starts at 300 nm. The thing I am wondering, how is it possible that at the top of the atmosphere there are no shorter wavelengths than 280 nm? For all I know at least UV-C (200 nm) should reach the ozone layer (Stratosphere). It makes me wonder if they only measured from 280nm onwards. What are your thoughts about this?

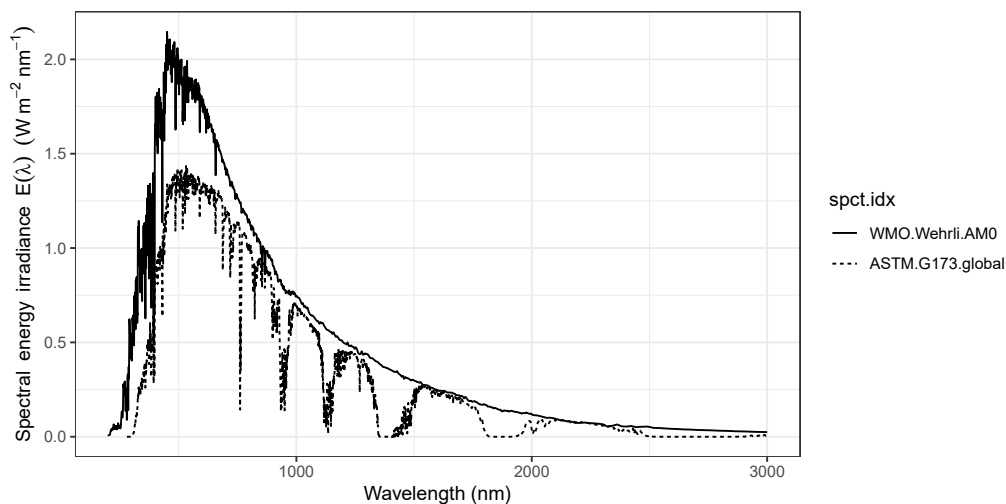
A1: Well spotted! You are correct, the extra-terrestrial solar spectrum is truncated in the figure. When these spectra are used in models as input for computing the spectrum at ground level, the shorter wavelengths are of no interest, but for the figure, of course, they are highly relevant!

I plotted the spectrum that the World Meteorological Organization normally uses. It comes from: Wehrli, C. (1985) Extraterrestrial solar spectrum. Pub. No. 615, World Radiation Center, Davos, Switzerland. The ASTM spectrum for global radiation is for 1.5 air-masses so for roughly an average year-round sun elevation for mid-latitudes. If you need data to make a fresh plot with both spectra, equivalent to the one you sent, the necessary data are all in my R package ‘photobiologySun’. If you use R (even if just a little) and want

annotated versions I can show you how to rather easily plot the combined plot.

```
library(photobiologySun)
library(ggspectra)
```

```
autoplot(sun_reference.mspect[c("WMO.Wehrli.AM0", "ASTM.G173.global")],
         annotations = "", range = c(50, 3000))
```



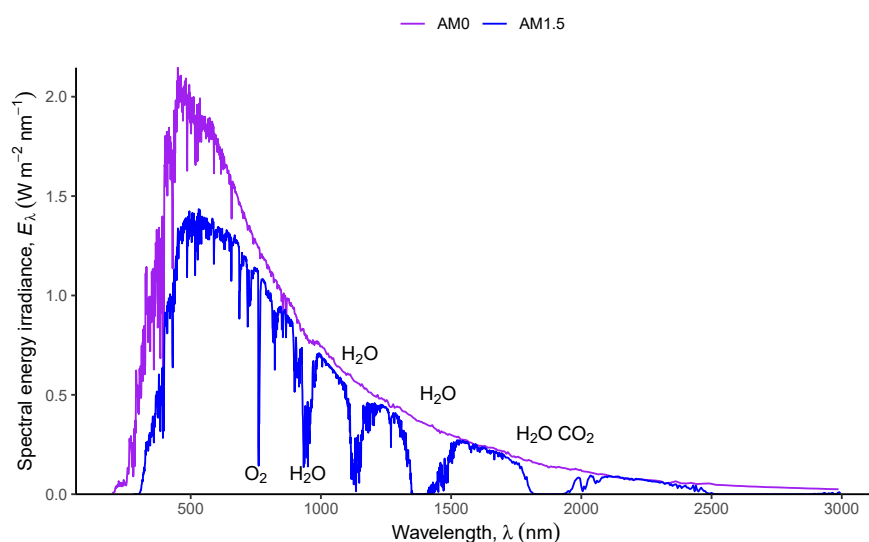
A1': Thank you for the fast reply and the help with getting the full data! I am very unfamiliar with R but I managed to get the graph from the code you sent over.

Q2: I am now trying to format the graph in R in a similar fashion as the original Graph I originally sent you but this also seems to fail. Any suggestions on this?

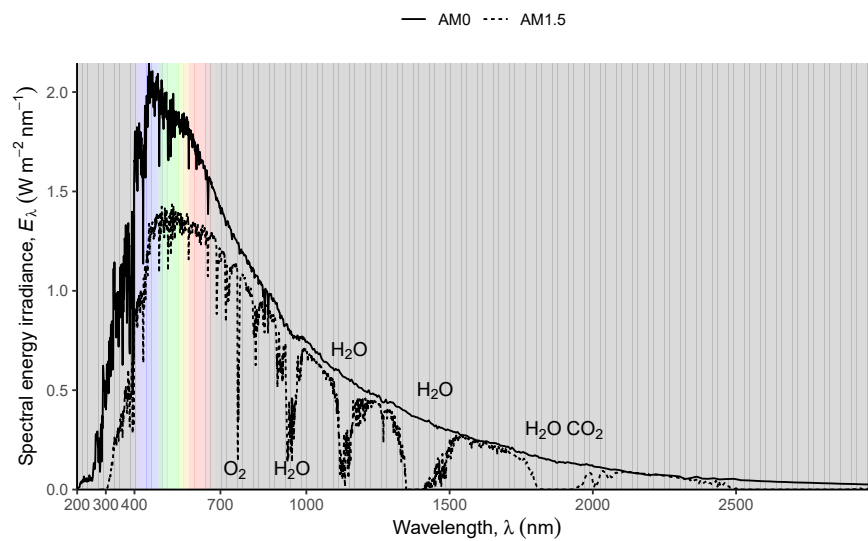
A2: Here are two examples that get you quite close to the original plot. I hope the code is not too intimidating...If you do not mind, I will include your question and this answer as a "Reader's question" in the UV4Plants Bulletin. It could be useful to others in addition to you and me. ;-)

```
ggplot(clip_wl(sun_reference.mspect[c("WMO.Wehrli.AM0", "ASTM.G173.global")],
             range = c(NA, 3000))) +
  aes(color = spct.idx) +
  geom_line() +
  scale_color_manual(name = "", labels = c("AM0", "AM1.5"), #
                    values = c("purple", "blue")) +
  scale_x_wl_continuous() +
```

```
scale_y_s.e.irrad_continuous(expand = c(0, 0)) +
annotate(
  geom = "text",
  x = c(750, 950, 1150, 1450, 1900),
  y = c(0.1, 0.1, 0.7, 0.5, 0.3),
  label = c("O2", "H2O", "H2O", "H2O", "H2O~CO2"),
  parse = TRUE
) +
theme_classic() +
theme(legend.position = "top")
```



```
ggplot(clip_wl(sun_reference.mspect[c("WMO.Wehrli.AM0", "ASTM.G173.global"]],
  range = c(NA, 3000))) +
aes(linetype = spct.idx) +
wl_guide(alpha = 0.15, color = NA) +
geom_line() +
scale_linetype_discrete(name = "", labels = c("AM0", "AM1.5")) +
scale_x_wl_continuous(expand = c(0, 0),
  breaks = c(200, 300, 400, 700, 1000, 1500, 2000, 2500)) +
scale_y_s.e.irrad_continuous(expand = c(0, 0)) +
annotate(
  geom = "text",
  x = c(750, 950, 1150, 1450, 1900),
  y = c(0.1, 0.1, 0.7, 0.5, 0.3),
  label = c("O2", "H2O", "H2O", "H2O", "H2O~CO2"),
  parse = TRUE
) +
theme_classic() +
theme(legend.position = "top")
```



A2': Thank you very much. Hope to see you on the next UV4PLANTS meeting!

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